Are Pesticide Buffers Expensive? Using Positive Mathematical Programming to Estimate the Cost of Proposed Pesticide Buffers in California

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Introduction

- Agricultural production in California currently relies on the use of pesticides to control for weeds, insects, and pathogens.
- Pesticide drift and runoff affect water quality.
- On February 1, 2010, the California Department of Pesticide Regulation (DPR) proposed draft regulations to reduce surface water contamination from pesticides.
- A key provision is the requirement of pesticide buffers of 25, 100, and 150 feet around sensitive aquatic sites dependent on the pesticide application method and active ingredient (AI).

Questions

For these proposed pesticide buffer regulations:

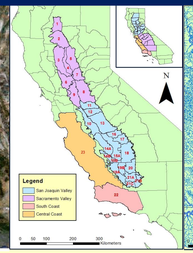
- What is the overall cost to California agriculture?
- What are the regional costs?
- How will California agriculture adapt?
- How will the change in crop patterns differ by region?

Methods

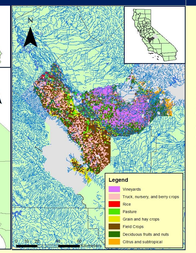
- A positive mathematical programming model is utilized to study the effects of pesticide buffers (Howitt 1995). The model structure is similar to the fixed-proportion model used in Merel, Simon, and Yi (2011), and the calibration methods used are developed in Merel, Simon, and Yi (2011) and Garnache and Merel (2012).
- The model has 31 water districts and 24 crop groups.
- The amount of land in water buffers is calculated using GIS for each crop-district pair using DWR land and NHD water data.
- Two different simulations: growers respond by (1) using alternative AIs (yield and cost shocks) in buffers **or**, (2) not planting in buffers

Central Valley

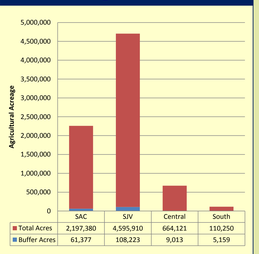
Water Districts



Crops in Fresno



Acreage in Buffers



	SAC	SJV	Central	South
Total Acres	2,197,380	4,595,910	664,121	110,250
Buffer Acres	61,377	108,223	9,013	5,159

Sources: Satellite image obtained from Google Maps™ on 06/01/2012; water district and land use data are from the California Department of Water Resources (DWR), and the water layer is from the National Hydrology Dataset (NHD)

Citations

Garnache, C., and P. Mérel. 2012. "Calibrating a programming model of agricultural supply under multiple constraints: a set of matryoshka doll." Working Paper, Department of Agricultural and Resource Economics, University of California, Davis.

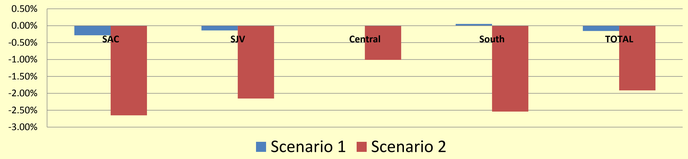
Howitt, R.E. 1995. "Positive Mathematical Programming." *American Journal of Agricultural Economics* 77(2):329-342.

Mérel, P., L.K. Simon, F. Yi. 2011. "A Fully Calibrated Generalized Constant-Elasticity-of-Substitution Programming Model of Agricultural Supply." *American Journal of Agricultural Economics* 93(4):936-948.

Results and Discussion

- The cost to California is between $27.2 to $457.1 million in lost revenue. The exact amount depends on the proportions of growers that respond to the regulations as modeled in Scenarios 1 and 2.
- The relative cost of the policy differs by region. Percentage wise, the Central Coast is the least affected region and the Sacramento Valley is the most affected region.

% Change in Total Revenue by Region



- In general, growers substitute away from the 100' buffer crops (strawberries and perennials) towards 25' buffer crops (annuals). In Scenario 1, growers also grow fewer crops that experience large yield losses (alfalfa, cotton, rice, and tomatoes). In Scenario 2, growers also respond by reducing the overall crop acreage.
- How growers adapt differs by region due to differing crop mixes.

% Change in Total California Acreage by Crop